

CRUISE RESULTS

Cruise 2003-01 F/V Arcturus
Cruise 2003-01 F/V Aldebaran

2003 Eastern Bering Sea Crab and Groundfish Survey

May-August 2003

The Resource Assessment and Conservation Engineering (RACE) Division of the Alaska Fisheries Science Center (AFSC) conducted the annual crab and groundfish bottom trawl survey of the eastern Bering Sea shelf from May to August 2003. This was a continuation of the annual series of eastern Bering Sea crab-groundfish assessment surveys which began in 1971.

OBJECTIVES

The primary objective of this survey was to continue the annual series of assessment surveys of crab and groundfish of the eastern Bering Sea to provide information for:

1. the North Pacific Fishery Management Council on the distribution, abundance, and biological condition of important groundfish and crab species;
2. the U.S. fishing industry on catch per unit effort and size composition, and;
3. the support of ongoing studies on the biology, behavior, and dynamics of key ecosystem components.

Secondary objectives were to:

1. conduct additional sampling in areas of high king crab and Tanner crab abundance to reduce variability in population estimates;

2. evaluate bottom trawl performance and configuration with net mensuration equipment and the calibration of the trawl warps;
3. sample nearshore sites near Togiak Bay, Kuskowim Bay, and Port Moller to investigate distribution of yellowfin sole and other species in areas immediately adjacent to the standard survey area;
4. collect and preserve specimens of fish and invertebrates of uncertain identification for a voucher data base;
5. collect stomach samples for trophic interaction studies;
6. collect and preserve various whole specimens and tissue samples from both fish and invertebrates for special studies;
7. estimate net efficiency of the survey trawl for skates, sculpins and other flatfish species and;
8. conduct an exploratory survey of the Pribilof canyon using echo-sign information to identify high density concentrations of semi-pelagic rockfish concentrations for future survey design.

VESSELS AND GEAR

Sampling at the standard sites was coordinated between two chartered commercial vessels, the *F/V Arcturus* and *F/V Aldebaran*. Both vessels were 39.6 m (130 ft) in length.

The bottom trawl used at all standard sampling stations was an 83-112 eastern trawl. These nets have a 25.3 m (83 ft) headrope and a 34.1 m (112 ft) footrope (Fig. 1). They were towed behind 1,000 kg, 1.8 X 2.7 m, steel V-doors and 54.9 m (180.1 ft) paired dandylines. Each lower dandyline had a 0.61 m chain extension connected to the lower wing edge to improve bottom tending characteristics.

Seawater temperature profiles were collected at most sampling sites using a micro-bathythermograph attached to the headrope of the net. Surface seawater temperatures were also collected with a bucket thermometer.

Net mensuration systems and bottom contact sensors aboard both vessels were used to provide sampling net configuration and performance data to be used in area-swept and catch-per-unit-effort (CPUE) calculations.

ITINERARY

The bottom trawl survey began in Dutch Harbor, Alaska on May 29. The *Aldebaran* and *Arcturus* completed the charter on August 2 in Dutch Harbor. Intervening port calls were made to Dutch Harbor on June 19 and July 10 to exchange scientific personnel. Additional port calls were made to St. Paul Island on June 29 and July 23 to exchange scientific and vessel personnel.

Prior to the beginning of the survey, both vessels marked the trawl warps using trawl wire meters. The vessel geometric counter read-outs were checked and calibrated to the mechanical meters to ensure that appropriate and consistent amounts of wire were used at all sampling sites as required by national and AFSC bottom trawl survey protocols.

Upon completion of the scheduled standard survey stations, the *Aldebaran* conducted some exploratory work in Pribilof Canyon to provide information on the nature of patches of semi-pelagic rockfish such as northern rockfish and Pacific Ocean perch. The purpose of this study was to evaluate the suitability of the Pribilof Canyon for future surveys that use echo-sign information to help designate the selection of trawl survey stations. Once this study was completed the *Aldebaran* proceeded to Pavlov Bay to conduct the shrimp survey.

Upon completion of its portion of the survey, the *Arcturus* conducted a special project to examine size dependent escapement of skate, sculpins, and other species under the footrope of the standard sampling net. An auxiliary net (underbag) was attached to the 83-112 sampling net to capture and assess the number of animals passing beneath the effective path of the survey trawl.

SURVEY DESIGN AND METHODS

The standard survey area is shown in Figure 2. Sampling sites were established on the basis of a 20 x 20 nm grid pattern used during previous surveys, although more intensive sampling was carried out in the Pribilof Islands and St. Matthew Island regions to collect additional data on crab populations.

The *Arcturus* and *Aldebaran* sampled alternate north/south columns of stations proceeding from Bristol Bay westward to the shelf edge. Tows of 30 minutes in duration were made at most sampling sites. All catches were sorted to the lowest possible taxon, weighed, and enumerated. Station data including time, position, trawl performance, distance fished as well as catch information were entered onto CD's with shipboard computer systems. Age samples (by sex-centimeter category), size composition, and other biological data were collected from the major fish species encountered. Length-width measurements, shell condition, clutch size, and tissues and organs for various studies were collected from the major crab species. Special study collections were stored in appropriate fixatives or were frozen.

RESULTS

The *Arcturus* and *Aldebaran* conducted 404 bottom trawls during the standard survey including 395 successfully completed trawls at scheduled sampling sites and 9 unsuccessful hauls. An additional 4 tows were made around a crab "hot spot" where more than 100 legal red king crab were encountered at one standard sampling site. These additional tows were conducted to reduce variability in the crab estimates.

Biological data collected from fish species are summarized in Table 1. The two vessels recorded 181,666 length measurements from the major fish species and 7,775 age structures were collected and preserved. Individual length-weight data were also recorded during the otolith collection process. A total of 5,610 stomachs were preserved from various fish taxa for feeding habit analysis.

Whole specimens and tissue samples of various fish and invertebrate species were preserved for identification, training, and other purposes.

The total standard survey area encompassed approximately 463,400 km². Catch rates of important fish and crab species, by depth zone, are shown in Table 2.

Walleye pollock (*Theragra chalcogramma*) was the most abundant round-fish species and had an overall CPUE of 181.7 kg/ha trawled. They were encountered at nearly all sampling sites, with largest mean catches (252.7 kg/ha) observed in central shelf waters at depths of 50-100 m (Fig. 3). Mean catches were much lower at depths less than 50 m (35.6 kg/ha).

Northern rock sole (*Lepidopsetta polyxystra*) and yellowfin sole (*Limanda aspera*) were the most abundant flatfish species, with overall CPUE values of 49.2 kg/ha and 48.2 kg/ha, respectively. Yellowfin sole were primarily restricted to the central and inner shelf waters, while rock sole were more broadly distributed with concentrations in Bristol Bay and around the Pribilof Islands (Figs. 4 and 5). Yellowfin sole catches decreased sharply with increased depth, from 115.0 kg/ha in waters less than 50 m to less than 0.1 kg/ha in waters greater than 100 m (Table 2). A similar depth-related decrease trend was also observed in rock sole abundance.

Pacific cod (*Gadus macrocephalus*) were encountered at most of the sites sampled (Fig. 6). Mean catch rates were smallest at inner shelf stations less than 50 m (7.4 kg/ha) and greatest in the central shelf region (18.6 kg/ha).

Alaska plaice (*Pleuronectes quadrituberculatus*), flathead sole/Bering flounder (*Hippoglossoides elassodon* and *H. robustus*), arrowtooth/Kamchatka flounder (*Atherestes stomias* and *A. evermanni*), and Pacific halibut (*Hippoglossus stenolepis*) had a combined catch rate of 35.8 kg/ha. Alaska plaice and arrowtooth flounder/Kamchatka flounder were the most abundant species of this group, with an overall catch rate of 9.9 kg/ha and 11.5 kg/ha respectively.

Snow crab (*C. opilio*) was most abundant in outer shelf waters and had a total overall average catch rate of 2.7 kg/ha. Red king crab (*P. camtschatica*) had an overall mean CPUE of 2.7 kg/ha while blue king crab (*P. platypus*) and Bairdi Tanner crab had overall catch rates of 0.3 kg/ha and 1.2 kg/ha trawled respectively.

SCIENTIFIC PERSONNEL^a**Arcturus****Leg 1** 5/29-6/19

F. Morado^b
 E. Acuna
 G. Lang
 J. Moser
 C. Armistead^d
 E. Burreson^e

Leg 2 6/19-7/10

B. Lauth^b
 D. Benjamin
 R. Clark
 A. Forbes
 C. Armistead^d
 I. Loyola^c

Leg 3 7/10-8/2

K. Weinberg^b
 S. Kotwicki
 E. Acuna^{7/10 - 7/23}
 B. Matta
 D. Cooper
 B. Otto^d 7/10 - 7/23
 D. Nichol^{7/23 - 8/2}
 D. Stevenson^{7/23 - 8/2}

Aldebaran**Leg 1** 5/29-6/19

T. Sample^b
 G. Mundell
 I. Loyola^c
 J. Brogan
 B. Mason
 P. Cummiskey^d

Leg 2 6/19-7/10

L. Britt^b
 S. Kotwicki
 P. Jenson
 M. Lloyd
 E. Munk^d
 A. Schroeder^f

Leg 3 7/10-8/2

J. Hoff^b 7/10 - 7/29
 D. Nichol^{7/10 - 7/23}
 D. Stevenson^{7/10 - 7/23}
 M. Yang
 P. Anderson^d
 B. O'Gorman^d
 P. Spencer^{7/23 - 7/29}
 D. Hanselman^g 7/23 - 7/29

^a Personnel from the AFSC, Seattle, unless otherwise noted

^b Field Party Chief

^c Personnel from the International Pacific Halibut Commission

^d Personnel from the AFSC, Kodiak Laboratory

^e Personnel from the Virginia Institute of Marine Sciences

^f Personnel from the United States Coast Guard

^g Personnel from AFSC, Auke Bay Laboratory

 For further information contact Dr. Gary Stauffer, Director, Resource
 Assessment and Conservation Engineering Division, Alaska Fisheries
 Science Center, National Marine Fisheries Service, 7600 Sand Point Way
 NE., Building 4, Seattle, WA 98115-0070 -- Telephone (206) 526-4170

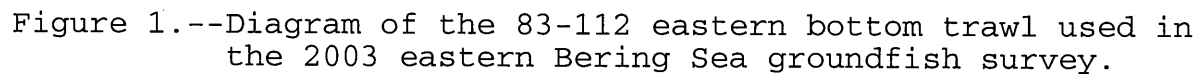
Table 1.--Biological data collected during the 2003 eastern Bering Sea crab-groundfish survey.

Species	Length measurements	Age structures ^{1/}	Stomach samples
Walleye pollock	46,780	1,638	2,537
Pacific cod	12,360	1,374	1,924
Yellowfin sole	30,060	756	-
Northern Rock sole	31,172	518	-
Flathead sole/ Bering flounder ^{2/}	20,119	640	-
Pacific halibut	2,039	836	276
Alaska plaice	8,961	320	--
Arrowtooth flounder/ Kamchatka flounder	16,373	--	461
Greenland turbot	622	435	258
Rex sole	1,738	--	--
Longhead dab	2,095	--	--
Plain sculpin	3,009	450	--
Great sculpin	725	375	-
Yellow Irish lord	551	223	
Starry flounder	792	--	--
Alaska skate	2,824	16	147
Bering skate	226	--	7
Pacific Ocean perch	173		
Misc. skates	49	--	-
Misc. species	998	194	-
Total	181,666	7,775	5,610

^{1/} Individual length-weight data were also collected.^{2/} Age structures were collected from flathead sole only.

Table 2.--Catch rates (kg/ha) by depth zone of commercially important fish and crab species taken aboard the *Arcturus* and *Aldebaran* during the 2003 eastern Bering Sea crab-groundfish survey.

Species	Inner shelf < 50 m	Central shelf 50-100 m	Outer shelf 100-200 m	Total area
Walleye pollock	35.6	252.7	192.1	181.7
Yellowfin sole	115.0	39.4	<0.1	48.2
Rock sole	102.3	47.0	1.8	49.2
Pacific cod	7.4	18.6	9.7	13.4
Alaska plaice	17.2	11.1	0.6	9.9
Flathead sole/ Bering flounder	1.3	13.8	16.4	11.3
Arrowtooth flounder/ Kamchatka flounder	0.4	9.9	33.0	11.5
Pacific halibut	3.5	3.0	2.8	3.1
Opilio Tanner crab	0.1	3.3	4.2	2.7
Red king crab	4.4	3.2	0.0	2.7
Bairdi Tanner crab	0.2	1.3	2.0	1.2
Blue king crab	0.0	0.6	<0.1	0.3



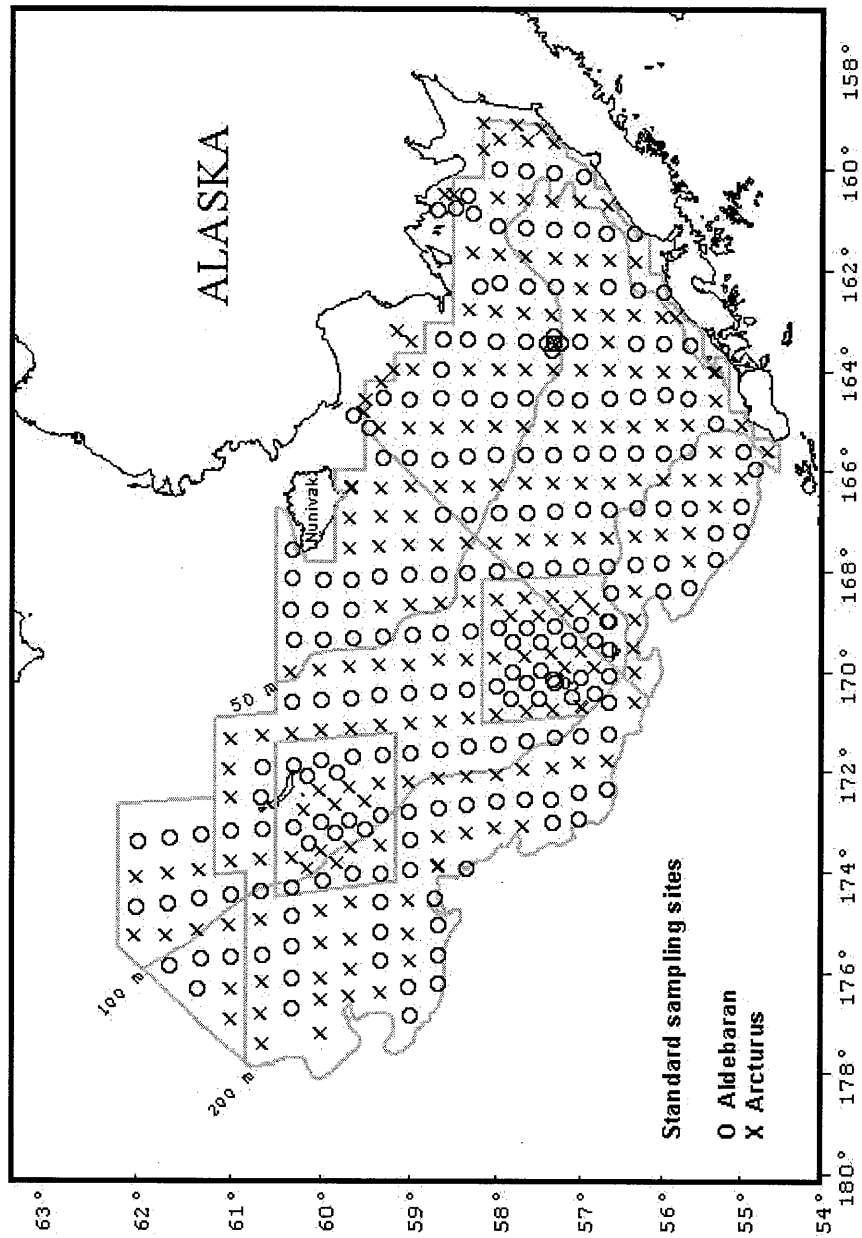


Figure 2.--Distribution of total sampling effort by the Aldebaran and Arcturus during the 2003 eastern Bering Sea bottom trawl survey.

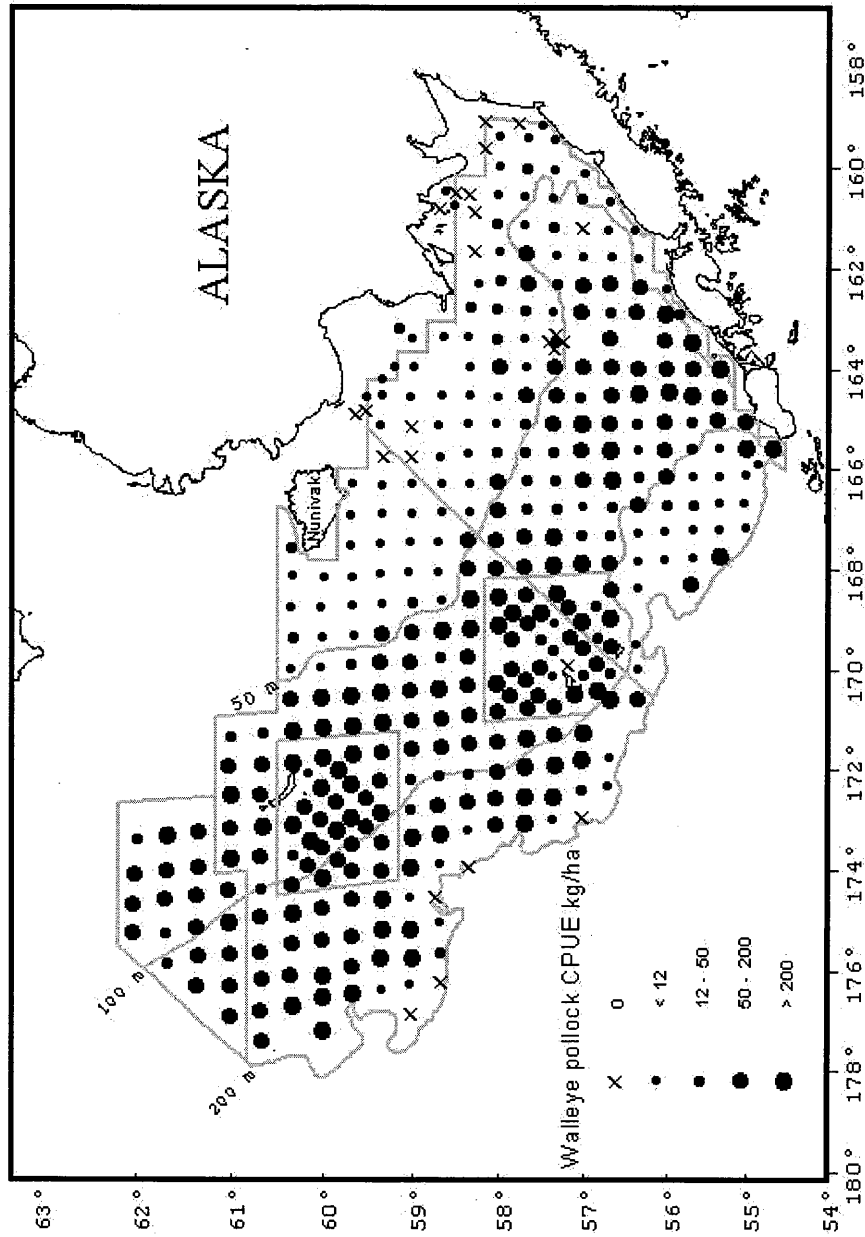


Figure 3.--Distribution and relative abundance of walleye pollock during the 2003 eastern Bering Sea bottom trawl survey.

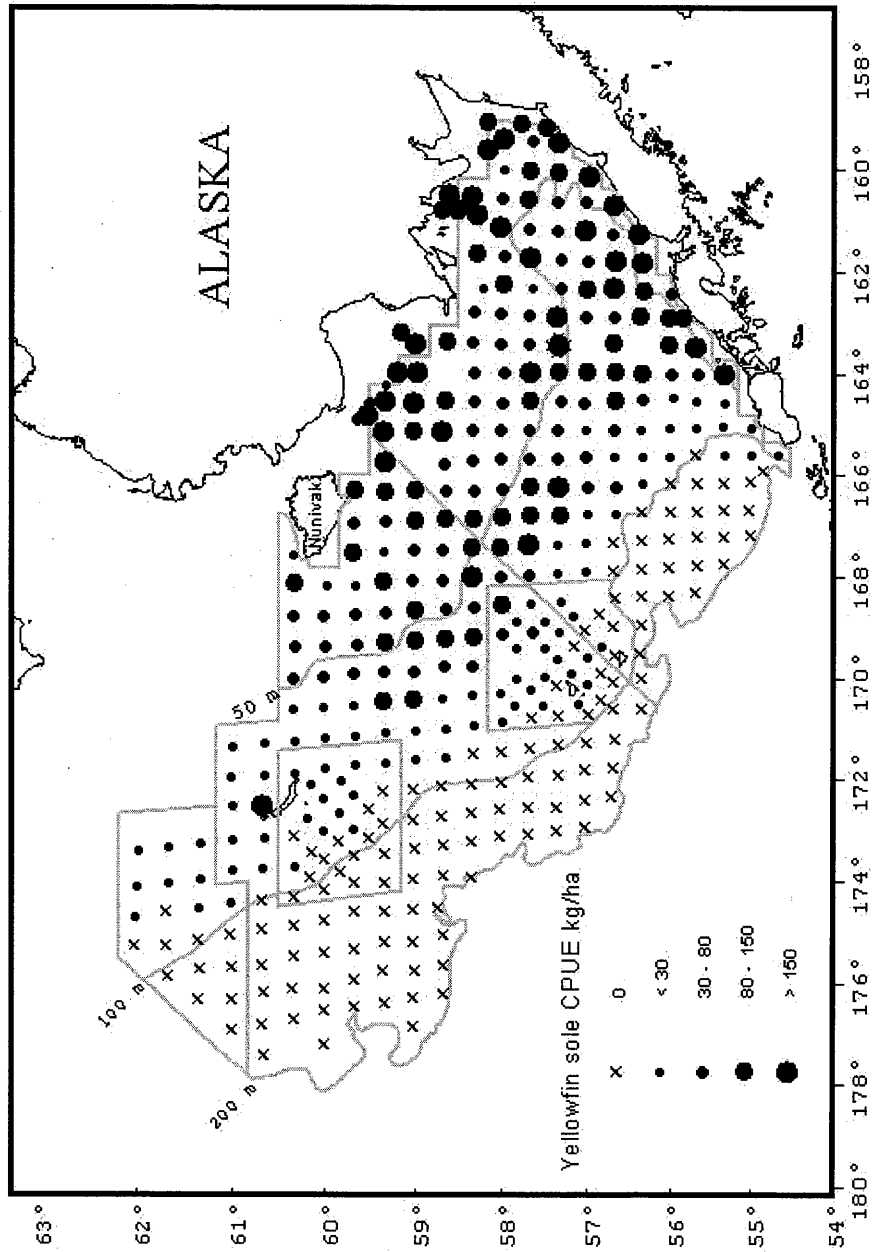


Figure 4.--Distribution and relative abundance of yellowfin sole during the 2003 eastern Bering Sea bottom trawl survey.

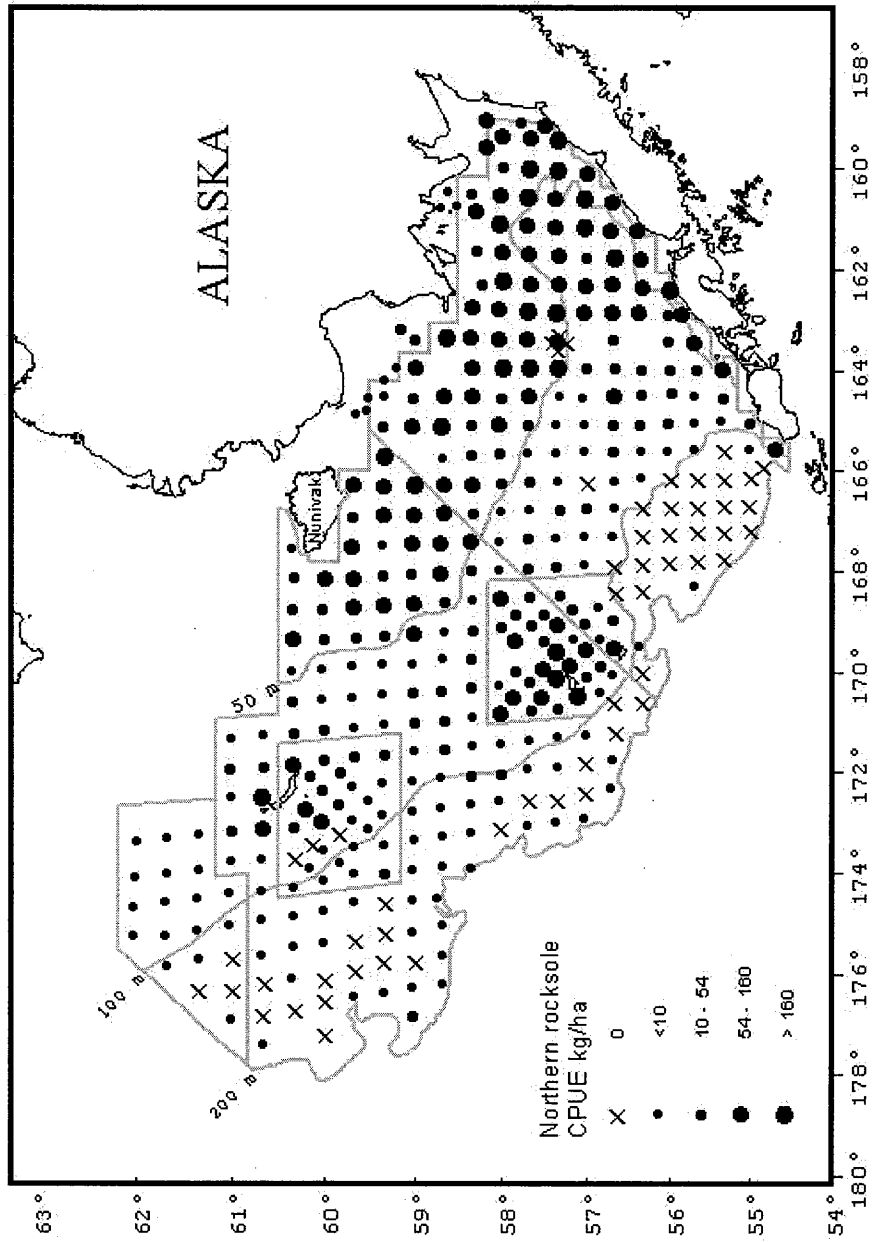


Figure 5.--Distribution and relative abundance of northern rock sole during the 2003 eastern Bering Sea bottom trawl survey.

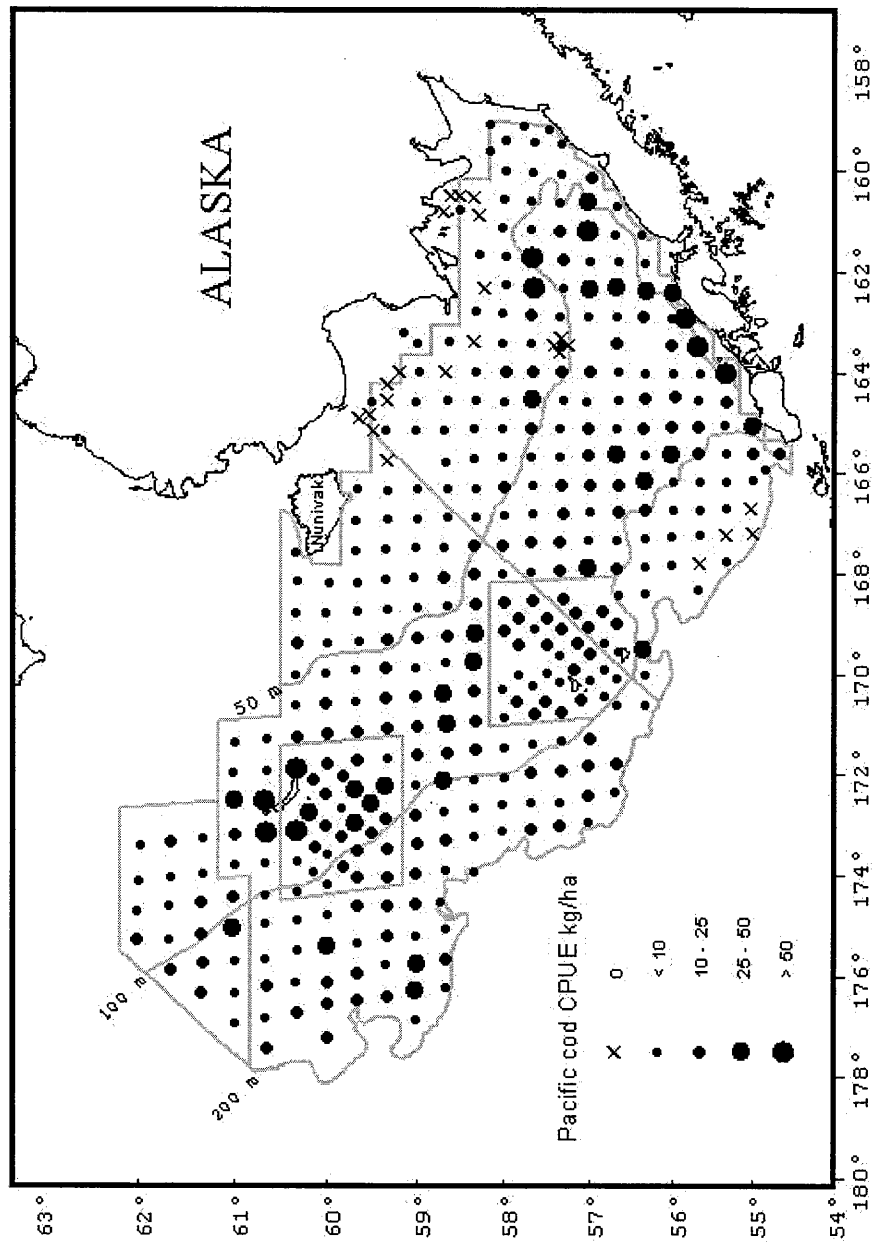


Figure 6.--Distribution and relative abundance of Pacific cod during the 2003 eastern Bering Sea bottom trawl survey.